Design and Engineering Plan Review
Considerations for Rolled and Hydraulic Erosion Control Products

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Today’s Discussion

- **RECPs**
  - Rolled Erosion Control Products

- **HECP**
  - Hydraulic Erosion Control Products
  - Hydraulically Applied Erosion Control Products
Why Use RECP’s

Applications for slopes, channel liners, & shorelines

- **Pros**
  - Immediate erosion protection
  - More aggressive treatment

- **Cons**
  - Labor intensive
  - Added costs
Increase Seed Germination
Temporary/Biodegradable Erosion Control Products

- Straw Mulch
- Hydraulic Mulch
- RECP’s
  - Jute
  - Straw
  - Excelsior
  - Coconut
  - Synthetic
RECP Types

Erosion Control Netting (ECN)

Open Weave Textiles (OWT)

Erosion Control Blankets (ECB)

Turf Reinforcement Mats (TRM)

Temporary
Degradable

Long Term
Non-degradable

Slopes
Channels
Erosion Control Netting (ECN)

- Planar woven natural fiber or extruded geosynthetic mesh
- Used as a component in RECP’s
- Used as a temporary degradable RECP to anchor loose fiber mulches
Open Weave Textiles (OWT)

- Temporary degradable
- Composed of processed natural or polymer yarns woven into a matrix
Erosion Control Blankets (ECB)

- Temporary degradable; processed natural or polymer fibers
- Mechanically, structurally, or chemically bound together to form a continuous matrix
Turf Reinforcement Mats (TRM)

- Composed of non-degradable synthetic fibers, filaments, nets, wire mesh, or other elements
- Processed into a permanent, three dimensional matrix
Other Considerations

- Hard Armor vs. Soft Armor
  - Rip Rap
  - Gabions
  - TRMs
    - Composite
    - Synthetic
  - Geocells
Product Types

- **Type 1 - Ultra Short Term**
  - 3 months

- **Type 2 - Short Term**
  - 12 months

- **Type 3 - Extended Term**
  - 24 months

- **Type 4 - Long Term**
  - 36 months

- **Type 5**
  - permanent
Manufacturer’s Anticipated Functional Longevity or Durability

ECTC Classification of RECPs

1A  1B  1C  1D
2A  2B  2C  2D
3A  3B
4   5A  5B  5C

3 Months
12 Months
24 Months
36 Months
Permanent
Configuration and Durability

### Table ECB-3 Typical Configuration and Durability of Temporary Erosion Control Blankets

<table>
<thead>
<tr>
<th>Class Designation</th>
<th>Usual Configuration</th>
<th>Typical Durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.A</td>
<td>Mulch control netting consisting of rapidly degrading photodegradable synthetic mesh or woven biodegradable natural fiber netting.</td>
<td>3 months</td>
</tr>
<tr>
<td>1.B</td>
<td>An erosion control blanket composed of processed rapidly degrading natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.</td>
<td>3 months</td>
</tr>
<tr>
<td>1.C</td>
<td>An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.</td>
<td>3 months</td>
</tr>
<tr>
<td>1.D</td>
<td>An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 rapidly degrading, synthetic or natural fiber nettings to form a continuous matrix.</td>
<td>3 months</td>
</tr>
<tr>
<td>2.A</td>
<td>Mulch control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting.</td>
<td>12 months</td>
</tr>
<tr>
<td>2.B</td>
<td>An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.</td>
<td>12 months</td>
</tr>
<tr>
<td>2.C</td>
<td>An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single degradable, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.</td>
<td>12 months</td>
</tr>
<tr>
<td>2.D</td>
<td>An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 synthetic or natural fiber nettings to form a continuous matrix.</td>
<td>12 months</td>
</tr>
<tr>
<td>3.A</td>
<td>Mulch control netting consisting of a slow degrading synthetic mesh or woven natural fiber netting.</td>
<td>24 months</td>
</tr>
<tr>
<td>3.B</td>
<td>An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.</td>
<td>24 months</td>
</tr>
</tbody>
</table>

### Table ECB-4 Typical Configuration and Durability of Permanent Erosion Control Blankets

<table>
<thead>
<tr>
<th>Class Designation</th>
<th>Usual Configuration</th>
<th>Typical Durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.A</td>
<td>A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.</td>
<td>Permanent</td>
</tr>
<tr>
<td>5.B</td>
<td>A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.</td>
<td>Permanent</td>
</tr>
<tr>
<td>5.C</td>
<td>A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.</td>
<td>Permanent</td>
</tr>
</tbody>
</table>
Typical Slope and Channel Applications

**Table ECB-1 Temporary Erosion Control Blanket Classes and Applications**

<table>
<thead>
<tr>
<th>Class</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.A</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.</td>
</tr>
<tr>
<td>1.B</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.</td>
</tr>
<tr>
<td>1.C</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.</td>
</tr>
<tr>
<td>1.D</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.</td>
</tr>
<tr>
<td>2.A</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.</td>
</tr>
<tr>
<td>2.B</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.</td>
</tr>
<tr>
<td>2.C</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.</td>
</tr>
<tr>
<td>2.D</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.</td>
</tr>
<tr>
<td>3.A</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.</td>
</tr>
<tr>
<td>3.B</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 1.5:1 and channels with shear stresses up to 2 pounds per square foot.</td>
</tr>
<tr>
<td>4</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 1:1 and channels with shear stresses up to 2.25 pounds per square foot.</td>
</tr>
</tbody>
</table>

**Table ECB-2 Permanent Erosion Control Blanket Classes and Applications**

<table>
<thead>
<tr>
<th>Class</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.A</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 8 pounds per square foot.</td>
</tr>
<tr>
<td>5.B</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 8 pounds per square foot.</td>
</tr>
<tr>
<td>5.C</td>
<td>Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 10 pounds per square foot.</td>
</tr>
</tbody>
</table>
ECTC Classification of RECPs

- 5H:1V: Mulch Control Netting
- 3H:1V: Open Weave Geotextile
- 2H:1V: Double Net ECB
- 1H:1V: Single Net ECB
- 1A
- 2A
- 3A
- 1C
- 3B
- 4
- 2C
- 1D
- 2D
- 5A
- 5B
- 5C

Typical Slope Applications
- 4H:1V: No Net ECB
- 2B

- 0.5H:1V: Turf Reinforcement Mat
- 5A
- 5B
- 5C
C – Factor Performance

- Cover Factor “C”

- Effectiveness – Primary soil loss value

- Ability to minimize soil movement during rain events
# Engineering Properties

## Table ECB-5 Minimum Physical Requirements for Erosion Control Blankets

<table>
<thead>
<tr>
<th>Property</th>
<th>Class</th>
<th>Minimum Tensile Strength (pounds/ft)</th>
<th>Minimum Permeability</th>
<th>Minimum Thickness (inches)</th>
<th>For Permanent Products (ASTM D 4355)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(ASTM D 4595) ²</td>
<td>Permeability % for Permanent</td>
<td>Permeability % for Temporary</td>
<td>Permeability % for Permanent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(pounds/ft²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(pounds/ft²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A ²</td>
<td>5</td>
<td>0.2</td>
<td>0.10 @ 5:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1B</td>
<td>5</td>
<td>0.2</td>
<td>0.10 @ 4:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1C</td>
<td>50</td>
<td>1.2</td>
<td>0.15 @ 3:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1D</td>
<td>75</td>
<td>1.7</td>
<td>0.20 @ 2:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2A ²</td>
<td>5</td>
<td>0.2</td>
<td>0.10 @ 5:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2B</td>
<td>5</td>
<td>0.2</td>
<td>0.10 @ 4:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2C</td>
<td>50</td>
<td>1.2</td>
<td>0.15 @ 3:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2D</td>
<td>75</td>
<td>1.7</td>
<td>0.20 @ 2:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3A ²</td>
<td>25</td>
<td>0.5</td>
<td>0.10 @ 5:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3B</td>
<td>100</td>
<td>2.0</td>
<td>0.15 @ 3:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>125</td>
<td>2.5</td>
<td>0.20 @ 2:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5A ²</td>
<td>125</td>
<td>6.0</td>
<td>0.10 @ 5:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5B ²</td>
<td>150</td>
<td>8.0</td>
<td>0.15 @ 3:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5C ²</td>
<td>175</td>
<td>10.0</td>
<td>0.20 @ 2:1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1. Minimum average roll values, minimum loading and/or high survivability is required.
2. Minimum shear stress calculated as ratio of maximum single stresses to soil loss from unprotected coastal areas or supported by periodic beach nourishment, water, or water contamination.
3. Permeability coefficient calculated as ratio of maximum single stresses to soil loss from unprotected coastal areas.
4. Minimum average roll values.
5. Other scale models used in conjunction with field conditions with high survivability in the presence of physical damage or excess damage.
6. Minimum shear stress calculated as ratio of maximum single stresses to soil loss from unprotected coastal areas.
7. Permeability coefficient calculated as ratio of maximum single stresses to soil loss from unprotected coastal areas. For performance test values should be obtained on the non-degradable portion of the matting alone.
Riparian Buffer Considerations

- Netless vs. Net
RECP Installation

- **Site Preparation**
  - Fine graded to a smooth profile
  - Free from clods, roots, stone, etc.

- **Seeding**
  - Select seed mix to the geological area

- **Trenching**
  - 6” deep by 6” wide anchor trench at top of slope

- **Staples**
Why is stapling important?
Installed Costs

- **Type 1** – $0.50 - $0.75/sy

- **Type 2**
  - Single Net - $1.50/sy
  - Double Net - $1.75/sy

- **Type 3** – $2.00 - $5.00/sy

- **Type 4** – $6.00/sy

- **Type 5** – $6.00 - $7.00/sy
HECP and RECP
Why use HECP’s

- Easy to Install
- Better contact with soil
- Site prep savings
Characteristics

- Quality raw materials – no germination inhibitors

- Long fiber lengths provide excellent erosion control and moisture absorption

- Thermally refined fibers provide greater moisture retention and ground coverage
HECP Types

- Hydraulic Mulch (HM)
- Stabilized Mulch Matrix (SMM)
- Bonded Fiber Matrix (BFM)
- Fiber Reinforced Matrix (FRM)
Hydraulic Mulch

- Contains defibrated paper, wood and/or natural fibers
- May or may not contain tackifiers
- Use on mild slopes
Stabilized Mulch Matrix

- Contains defibrated organic fibers with at least one of the following:
  - Soil flocculants
  - Cross linked hydro-colloidal polymers
  - Cross linked tackifiers

- Use on moderate slopes
Bonded Fiber Matrix

- Matrix containing organic defibrated fibers and cross-linked insoluble hydro-colloidal tackifiers
- Use on steep slopes
Fiber Reinforced Matrix

- Matrix containing organic defibrated fibers
- Cross linked insoluble hydro colloidal tackifiers and reinforcing natural or synthetic fibers
- Use on very steep slopes
## Application Rates

<table>
<thead>
<tr>
<th>Type</th>
<th>Functional Longevity</th>
<th>Typical Application Rates (lbs/ac)</th>
<th>Typical Maximum Slope Gradient (H:V)</th>
<th>Maximum Uninterrupted Slope Length (ft)</th>
<th>Maximum C Factor</th>
<th>Minimum Vegetation Establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HM</td>
<td>up to 3 mo.</td>
<td>2000-3000</td>
<td>≤ 3:1</td>
<td>25</td>
<td>0.5</td>
<td>150%</td>
</tr>
<tr>
<td>SMM</td>
<td>min. 3 mo.</td>
<td>2000-3500</td>
<td>≤ 2:1</td>
<td>50</td>
<td>0.15</td>
<td>200%</td>
</tr>
<tr>
<td>BFM</td>
<td>min. 6 mo.</td>
<td>2500-4000</td>
<td>≤ 1:1</td>
<td>75</td>
<td>0.1</td>
<td>300%</td>
</tr>
<tr>
<td>FRM</td>
<td>min. 12 mo.</td>
<td>3000-4500</td>
<td>≤ 0.5:1</td>
<td>100</td>
<td>0.02</td>
<td>400%</td>
</tr>
</tbody>
</table>
Mixing Techniques

- **Mechanically Agitated Machines**
  - Have paddles to mix slurry in tank
  - Can use a wide range of fiber mulch materials

- **Jet Agitated Machines**
  - Generally smaller machines that mix slurry with jets
  - May have difficulty pumping wood based fiber mulch materials
HECP Research

- 30’ x 200’ area
- 20 plots
- 5 treatments were applied
- Each treatment replicated 4 times
<table>
<thead>
<tr>
<th>Plot Type</th>
<th>HM subsample weight (g)</th>
<th>DOT recommended rate (lb/ac)</th>
<th>Actual application rate (lb/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% wood</td>
<td>6.7</td>
<td>2000</td>
<td>3300</td>
</tr>
<tr>
<td>100% wood</td>
<td>8.4</td>
<td>2000</td>
<td>4100</td>
</tr>
<tr>
<td>100% wood</td>
<td>12.6</td>
<td>2000</td>
<td>6200</td>
</tr>
<tr>
<td>100% wood</td>
<td>11.8</td>
<td>2000</td>
<td>5800</td>
</tr>
<tr>
<td>BFM</td>
<td>17.3</td>
<td>3500</td>
<td>8500</td>
</tr>
<tr>
<td>BFM</td>
<td>7.7</td>
<td>3500</td>
<td>3700</td>
</tr>
<tr>
<td>BFM</td>
<td>10.1</td>
<td>3500</td>
<td>4900</td>
</tr>
<tr>
<td>BFM</td>
<td>11.2</td>
<td>3500</td>
<td>5500</td>
</tr>
<tr>
<td>70/30</td>
<td>6.8</td>
<td>2500</td>
<td>3300</td>
</tr>
<tr>
<td>70/30</td>
<td>6.5</td>
<td>2500</td>
<td>3200</td>
</tr>
<tr>
<td>70/30</td>
<td>9.3</td>
<td>2500</td>
<td>4500</td>
</tr>
</tbody>
</table>
Hydromulch Research

- Event 1 - 3.87” rainfall
- Event 2 - 1.55” rainfall
- Event 3 - 2.07” rainfall
Results looked good compared to check.

Only BFM that can be used over Straw
New Test Areas
Potential to save on matting quantities.

Resident & Contractor Prefer BFM
About half the cost of matting: $4700/ac

Matting can be expensive if you have to re-walk and re-mat.
Straw Matting

BFM Area

Easier to patch than matting.

Matting

BFM

Matted Area

Matting

Patched Area
Aerial Hydro Mulching
Installed Costs

- Hydraulic Mulch - $1500-$3000/ac
- Stabilized Mulch Matrix - $3000-$4000/ac
- Bonded Fiber Matrix - $4000-$5000/ac
- Fiber Reinforced Matrix - $5000-$6000/ac
Summary

- A right tool for every job!

- Select product based on engineering properties and site/slope warrants

- HECP’s may serve as equivalent to some RECP’s at a cost savings
Questions

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